

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

Planetary Research at Lowell Observatory
NGR-03-003-001

PERFORMING ORGANIZATION

Lowell Observatory
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INVESTIGATOR'S NAME

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DESCRIPTION (a. Brief statement on strategy of investigation; b. Progress and accomplishments of prior year; c. What will be accomplished this year, as well as how and why; and d. Summary bibliography)

(a) Research under this grant currently deals largely with comets. Scientific goals include a better determination of the basic physical characteristics of cometary nuclei, a more complete understanding of the complex processes in the comae, a survey of abundances and gas/dust ratios in a large number of comets, and a measurement of primordial $^{12}\text{C}/^{13}\text{C}$ and $^{14}\text{N}/^{15}\text{N}$ ratios. Our program also includes the observation of Pluto-Charon mutual eclipses to derive dimensions.

(b) During the reporting period we completed reduction and analysis of extensive narrowband photometry of Comet Halley from Cerro Tololo Inter-American Observatory, Perth Observatory, Lowell Observatory, and Mauna Kea Observatory. We have shown that the 7.4-day periodicity in the activity of Comet Halley, discovered earlier by Millis and Schleicher, was present from late February through at least early June 1986, but there is no conclusive evidence of periodic variability in the preperihelion data. Greatly improved NH scalelengths and lifetimes have been derived from the Halley data which lead to the conclusion that the abundance of NH in comets is much higher than previously believed. Simultaneous optical and thermal infrared observations were obtained of Comet P/Tempel 2 (in collaboration with M.F. A'Hearn and H. Campins) using the MKO 2.2 m telescope and the NASA IRTF. Preliminary analysis of these observations shows that the comet's nucleus is highly elongated, very dark, and quite red. We obtained CCD imaging observations of Comets P/Borrelly, Furuyama, Bradfield, Liller, and P/Tempel 2. CCD luminosity profiles of 14 selected comets were prepared for publication, and work was continued on the modeling of continuum luminosity profiles in terms of radiation pressure and grain evolution. Analysis of high-resolution spectra of P/Halley, recorded in the region of the CN violet bands, was begun for the purpose of extracting the $^{12}\text{C}/^{13}\text{C}$ ratio in this molecule. Two Pluto-Charon mutual events were observed. Narrowband CCD imaging of Jupiter with methane and ammonia filters was explored. In August we hosted an international workshop on *Time-Variable Phenomena in the Jovian System*, in which 115 planetary scientists participated.

(c) Major papers discussing the periodic variability and overall photometric behavior of Comet Halley will be completed and published. Analysis of the optical and infrared observations of Comet P/Tempel 2 will be completed and the results published. Existing photometry of more than 70 comets which we have observed since 1976 will be reduced to a common photometric system and the results discussed in terms of the group properties of comets. Observations of Comet P/Brorsen-Metcalf and other well-placed comets are planned in order to search for periodic variability, test the recent results on NH, and extend our data base. Publication of existing luminosity profile data will be completed, and the modeling of our data in terms of grain properties will be continued. Analyses of high resolution spectra of P/Halley will be extended. We plan to observe several Pluto-Charon events.

d) Bibliography of papers published or in press during the past year.

- A'Hearn, M., Campins, H., and Schleicher, D. (1988). The Nucleus of Comet P/Tempel 2. IAU Circular No. 4614.
- Baum W. A., Kreidl, T. J., and Schleicher, D. G. (1987). Assaying Cometary Grains. *Bull. Amer. Astron. Soc.* **19**, 868.
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- Carlson, B. E., and Lutz, B. L. (1988). Spatial and temporal variations in the atmosphere of Jupiter: Polarimetric and photometric constraints. In *Proceedings of the International Workshop on Time-Variable Phenomena in the Jovian System* NASA Special Publication (eds. M. J. Belton and R. A. West), in press.
- Lutz, B. E. (1987). The solar system/interstellar medium connection: gas phase abundances. Invited review in *Interstellar Processes* (eds. D. J. Hollenbach and H. A. Thronson), D. Reidel, Dordrecht.
- Millis, R. L., A'Hearn, M. F., and Campins, H. (1988). An investigation of the nucleus and coma of Comet P/Arend-Rigaux. *Astrophys. J.* **324**, 1194-1209.
- Millis, R. L., Schleicher, D. G., Birch, P. V., Martin, R., and A'Hearn, M. F. (1987). Production of Gas and Dust by Comet Halley. *Bull. Amer. Astron. Soc.* **19**, 880.
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- Schleicher, D. G., and Millis, R. L. (1988). Revised Scalelengths for Cometary NH. *Astrophys. J.*, submitted.
- Schleicher, D. G., Millis, R. L., and Birch, P. V. (1987). Photometric Observations of Comet P/Giacobini-Zinner. *Astron. Astrophys.* **187**, 531-538.
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- Schleicher, D. G., Millis, R. L., Tholen, D. J., Hammel, H. B., Piscitelli, J. R., Lark, N., Birch, P. V., and Martin, R. (1988). The Variability of Comet Halley During the 1985/1986 Apparition. In preparation.